

## Role of High Resolution Ultrasonography (USG) In Ocular Pathologies

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### Abstract

**Background:** Ultrasound is a noninvasive procedure to diagnose ocular pathologies. It can be used to differentiate ocular and extraocular diseases, to evaluate orbital trauma and to localize intraocular foreign body. It is of great help where ophthalmoscopy is impossible mainly due to opacification of transparent media. **Aim & Objective:** Study was to evaluate the role of USG in ocular diseases & correlate our finding with ophthalmoscopy (clinical) findings. **Subjects and Methods:** Study was done on 50 patients in Radiology department of Muzaffarnagar medical college, Muzaffarnagar, U.P. Examination was done using Ultrasonography (USG) machine- Philips 650 Clear vue with 5 - 12 MHz linear probe. **Results:** In our study ocular pathologies (includes extraocular) were most commonly seen between 6th to 7th decade (44%) with female predominance (64 %). Left eye (52%) showed slightly predominance however 14% of cases having bilateral involvement. Commonest ocular pathology was retinal detachment & cataract with equal weightage (20.5 %) followed by vitreous hemorrhage (15.3 %). Out of 11 extraocular cases, 4 were cysticercosis (36.3%) in our study. Out of 50 cases, 39 cases were diagnosed ocular pathologies & 11 cases were diagnosed extraocular pathologies. Out of them 47 were diagnosed correctly on USG while only 16 cases were diagnosed correctly by ophthalmic examination. **Conclusion:** USG is useful in diagnosing ocular conditions. USG had better sensitivity and specificity for both intraocular and extraocular pathologies than ophthalmoscope due to opaque media. Moreover, ultrasonography provide a cost-effective, radiation free, non-invasive technique in patients with ocular pathologies.

**Keywords:** Ultrasonography, Vitreous Hemorrhage, Retinal Detachment.

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### Introduction

Eyes represent 0.1% of total body surface out of which only 0.27% of the anterior body surface shows their significance to the individuals and society is disproportionately higher & most information reaches humans through vision.<sup>[1]</sup> Ocular complaints comprise an estimated 3% of all emergency.<sup>[2]</sup> B-scan ultrasonography (USG) is a valuable diagnostic imaging technique in the field of ophthalmology.<sup>[4]</sup> It is cheap, innocuous, easily accessible, easy to perform and accurate. There is no exposure to radiation, and sedation is not necessary.<sup>[5]</sup> The cystic nature of eye, its superficial location and high frequency transducers make it possible to clearly demonstrate detailed cross-sectional anatomy and pathology of eye and orbit.<sup>[3]</sup>

B-scan is a real time two dimensional USG of eye and orbit.<sup>[6]</sup> USG has better clinical assessment of a variety of ocular disease, when ophthalmoscopy is not possible as there is opacification of transparent media like in mature cataract or vitreous haemorrhage.<sup>[7]</sup>

Ultrasound can differentiate many intraocular and intraorbital disorders.<sup>[4]</sup> Vitreous pathological conditions may demonstrate echoes caused by various entities such as

degeneration, asteroid hyalosis, hemorrhage and infection and lines are indicative of different types of detachment, including retinal, choroidal, and hyaloids detachment and retinoschisis.<sup>[5]</sup>

Color Doppler is helpful in diagnosis of ocular tumours as well as in the follow up after conservative treatment. This technique can detect vascularity & quantify these tumors. This reduces even before the tumor diminishes in size, giving an early clue to the activity of therapy.<sup>[8,9]</sup>

### Aim and Objectives

- 1) To evaluate the Sonographic findings in suspected ocular pathologies.
- 2) To evaluate the correlation between ophthalmoscopic (Clinical) findings and ultrasonographic findings.

### Subjects and Methods

A prospective correlational study was conducted over a period of 18 months on 50 patients in the Department of Radiodiagnosis & Imaging, Muzaffarnagar medical college, U.P. The patients were evaluated with high resolution ultrasonography and colour Doppler imaging using high

frequency linear probe of Philips 650 Clear vue with 5 - 12 MHz linear probe. USG was done in supine position with closed eyelid after application of coupling gel utilizing contact method. Longitudinal and transverse axis scans was performed, both in static and with dynamic movements of eye after instructing the patients. The ultrasonographic diagnoses were correlated with the clinical findings.

**Results**

In our study, orbital pathologies were most commonly seen between 6th to 7th decade (44%) with female predominance (64 %). Unilateral eye involvement was noted in (86%) out of which left eye (52%) showed slightly predominance with 14% of cases having bilateral involvement.

**Table 1: Distribution of extra-ocular and intra-ocular lesions among study subjects. (N = 50)**

Lesion Location	Number Of Patients	Percentage
Intra-ocular	39	78 %
Extra-ocular	11	22 %

**Table 2: Distribution of primary disease condition among patients in the study. (N = 50)**

Primary Disease Condition		Number	Percentage in group
Intra-ocular disease conditions (N =39 )	Retinal Detachment	08	20.5 %
	Cataract	08	20.5 %
	Vitreous Detachment	02	5.1 %
	Foreign Body	02	5.1 %
	Posterior Staphyloma	02	5.1 %
	Vitreous Hemorrhage	06	15.3 %
	Choroidal Detachment	01	2.5%
	Dislocated Lens	02	5.1%
	Vitreous Degeneration	02	5.1 %
	Globe Rupture	01	2.5 %
	Phthisis Bulbi	02	5.1 %
	Retinoblastoma	01	2.5 %
	Endophthalmitis	01	2.5 %
Extra-ocular disease conditions (N = 11)	Asteroid Hyalosis	01	2.5 %
	Cysticercosis	04	36.3%
	Cellulitis	01	9 %
	Lacrimal Cyst	01	9 %
	Hemangioma	01	9 %
	Lymphoma	01	9 %
	Dacrocystocele	01	9%
Meningioma	02	18.1 %	

**Table 3: Correctness of diagnosis by Ophthalmic Examination compared to USG according to Primary Diagnosis (N = 50)**

Primary Diagnosis	Ophthalmic Examination		USG finding		Total
	Correct (%)	Incorrect (%)	Correct (%)	Incorrect (%)	
Cataract	1(12.5%)	7 (87.5%)	8 (100.0%)	0(0.0%)	8 (100.0%)
Choroidal Detachment	0 (0.0%)	1 (100.0%)	1 (100.0%)	0 (0%)	1(100.0%)
Asteroid Hyalosis	0 (0%)	1(100%)	1 (100.0%)	0(0.0%)	1 (100%)
Cellulitis	0 (0%)	1 (100.0%)	1 (100%)	0(0.0%)	1 (100.0%)
Lacrimal Cyst	0 (0%)	1 (100.0%)	1 (100.0%)	0 (0%)	1 (100.0%)
Cysticercosis	0 (0%)	4 (100.0%)	4 (100%)	0 (0.0%)	4 (100.0%)
Dislocated Lens	1 (50.0%)	1 (50.0%)	2 (100.0%)	0 (0%)	2 (100.0%)
Foreign Body	1 (50.0%)	1 (50.0%)	2 (100.0%)	0 (0%)	2 (100.0%)
Haemangioma	0 (0%)	1 (100.0%)	1 (100.0%)	0 (0%)	1 (100.0%)
Globe Rupture	0 (0%)	1 (100.0%)	1 (100.0%)	0 (0%)	1 (100.0%)
Endophthalmitis	1 (100.0%)	0 (0%)	1 (100.0%)	0 (0%)	1 (100.0%)
Vitreous Detachment	1(50.0%)	1 (50.0%)	1 (50.0%)	1 (50.0%)	2 (100.0%)
Phthisis Bulbi	0 (0%)	2 (100.0%)	2 (100.0%)	0 (0%)	2 (100.0%)
Retinal Detachment	3 (37%)	5 (62.5%)	7 (87.5%)	1 (12.5%)	8 (100.0%)
Retinoblastoma	0 (0%)	1 (100.0%)	1 (100%)	0 (0.0%)	1 (100.0%)
Meningioma	1 (50.0%)	1 (50.0%)	2 (100%)	0 (0.0%)	2 (100.0%)
Lymphoma	0 (0%)	1 (100.0%)	0 (0.0%)	1 (100%)	1 (100.0%)
Dacrocystocele	0 (0%)	1 (100.0%)	1 (100%)	0 (0%)	1 (100.0%)
Vitreous Degeneration	1 (50.0%)	1 (50.0%)	2 (100.0%)	0 (0%)	2 (100.0%)
Vitreous Haemorrhage	4 (66.7%)	2 (33.3%)	6 (100.0%)	0 (0%)	6 (100.0%)
Posterior Staphyloma	2(100.0%)	0(0.0%)	2(100.0%)	0(0.0%)	2(100.0%)
Total	16 (32 %)	34 (68 %)	47 (94 %)	3 (6 %)	50(100.0%)

**Table 4: Showing sensitivity (%), specificity (%), PPV(%) and NPV(%) Between ophthalmic and sonological diagnosis.**

Parameter	Ophthalmic Diagnosis	Sonological Diagnosis
SENSITIVITY	36.3%	93.2%
SPECIFICITY	100%	100%
PPV	100%	100%
NPV	17.6%	66.6%
ACCURACY	44%	94%

**Discussion**

Extraocular pathology comprises only 11 patients (22%) whereas intra ocular pathology (78%) amounts to majority

of patients. Similar results were showed by OP Sharma et al,<sup>[10]</sup> Rashmi et al,<sup>[11]</sup> & others that intraocular pathologies were more common than extraocular pathologies.

Most common diagnosis in our study was retinal detachment & cataract (20.5%) followed by vitreous hemorrhage (15.3%). Neeru Chaudhary et al,<sup>[12]</sup> showed that retinal detachment more commonly followed by cataract. Hiren Rathod et al,<sup>[13]</sup> showed in their study that choroidal detachment more commonly followed by vitreous hemorrhage

Totally 47 out of 50 cases (94%) were correctly diagnosed by ultrasound whereas only 16 (32%) were correctly diagnosed on ophthalmic examination. All 8 cataract cases

were diagnosed correctly on ultrasound whereas only one cataract was diagnosed by ophthalmoscopic examination and out of 8 retinal detachment cases, one was missed by USG in comparison to 5 missed by ophthalmic examination. In patients following trauma, USG was found to be very useful in diagnosing dislocated lens, foreign bodies and posterior capsular rupture with 100% sensitivity. In our study, including retinoblastoma, all other benign and malignant conditions (Lacrimal cyst, phthisis bulbi, hemangioma, dacryocystocele and meningioma) could be correctly diagnosed with USG compared to ophthalmic examination.

In our study, the overall sensitivity, specificity, PPV, NPV and accuracy of ultrasound for the diagnosis of ocular pathologies were 93.2%, 100.0%, 100.0%, 66.6% & 94% respectively compared to 36.3%, 100.0%, 100.0%, 17.6% & 44%, for ophthalmoscopic examination. In OP Sharma's study,<sup>[10]</sup> it was documented that Ultrasound was 100% effective in differentiating intra and extraocular pathologies with 97% accuracy for diagnosing VH, 99% for RD and 100% for lacrimal gland and optic nerve tumours. Rashmi et al,<sup>[11]</sup> noted the overall sensitivity, specificity, PPV, NPV and accuracy of ultrasound for the diagnosis of ocular pathologies as 94.2%, 98.8%, 99.1%, 92.2% and 94.9% (p-value < 0.0001) respectively compared to 62.5%, 98.8%, 98.7%, 64.8% and 62.7% for ophthalmoscopic examination.

**Extraocular pathologies:**

**Extraocular Cysticercosis:** 4 cases presented with localized swelling in periocular region, ultrasound revealed solitary cystic lesion with eccentric echogenic scolex. Ultrasound was able to diagnose these cases correctly with a sensitivity of 100%.

**Preseptal cellulitis:** Patient came with diffuse swelling involving upper eyelid and severe pain. Ultrasound revealed an irregular heterogeneous collection in the upper eyelid with internal echoes and adjacent inflammatory edema.

**Hemangioma:** 1 case of hemangioma was noted in our study. Ultrasound was 100% sensitive, 100% specific and 100% accurate in diagnosing hemangioma in our study.

**Ocular pathologies:**

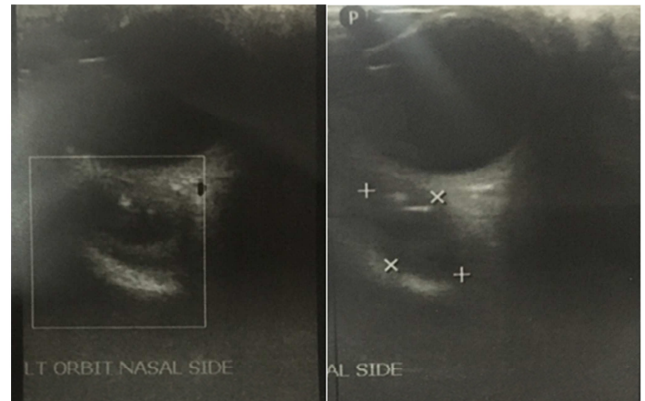
**Cataract:** Of the 8 cases of cataract, all cases were correctly diagnosed by ultrasound which showed echogenic anterior and posterior cortex of lens. The sensitivity and specificity being 100% and 92.4% respectively with an accuracy of 96%.

**Vitreous haemorrhage:** All the 6 cases were diagnosed on ultrasound. Ultrasound was 100% sensitive, 90.2% specific and 92.6% accurate in diagnosing VH. Sharma OP10 found ultrasound to be 97% sensitive for diagnosing VH.

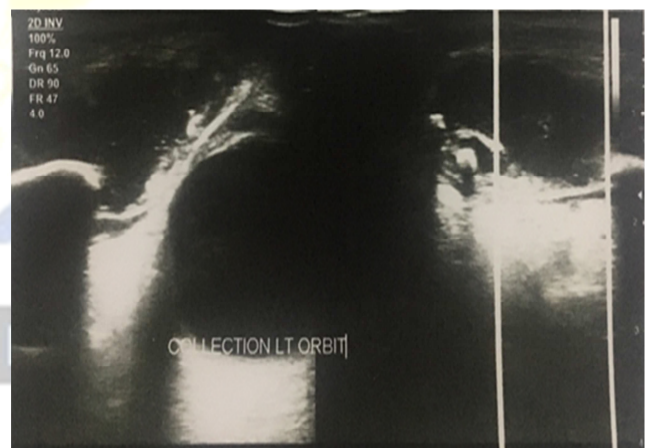
**Retinal detachment:** Ultrasound diagnosed 7 cases out of 8 of RD in our study. On USG, retinal detachment appeared as continuous, smooth membranes in vitreous which was attached to ora serrata anteriorly & optic disc posteriorly. Jemeld B et al,<sup>[14]</sup> found ultrasound to be 78% accurate for diagnosing RD.

**Retinoblastoma:** 1 case of RB was in the first decade in our study and were correctly diagnosed by ultrasound which showed heterogeneous mass lesion occupying eye ball mostly loss of normal anatomical details with increased

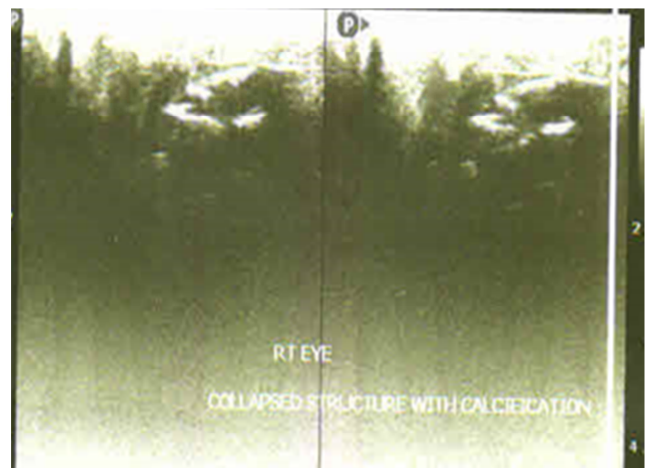
colour flow signal. The mass lesion showed multiple tiny areas of calcification. Zilelioglu G et al<sup>15</sup> in his study found ultrasound to be correct in diagnosing 87.12% of retinoblastoma. The results were false negative in 9.09% and false positive in 3.79% of cases.



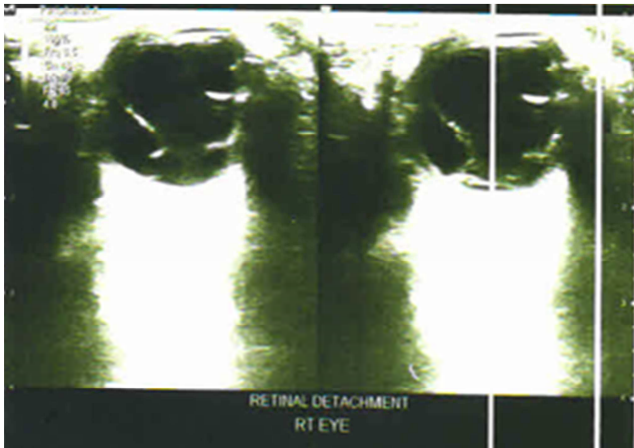
**Figure 1A&B: Cysticercosis Well Defined Cystic Lesions With Eccentric Echogenic Nodule Representing Scolex, In The Extra Ocular Muscles.**



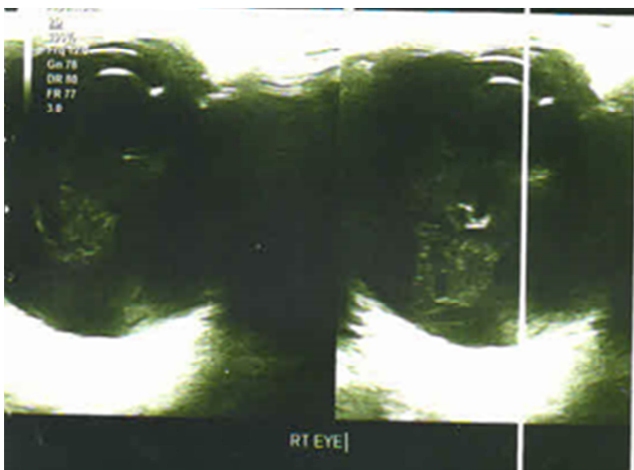
**Figure 2: Abscess & Foreign Body: Irregular heterogenous collection with multiple air foci within causing dirty shadowing, in the preseptal and upper eyelid region.**



**Figure 3: Pthisis Bulbi: Irregular Deformed Globe with Specs of Calcification.**



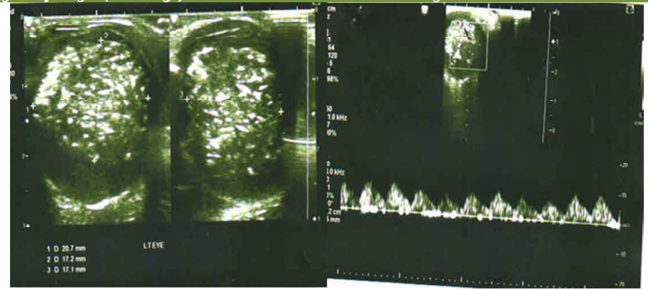
**Figure 4: Retinal detachment: well defined thick echogenic v-shaped retinal folds attached to optic disc and ora serrata.**



**Figure 5: Vitreous hemorrhage-echogenic and floating membranes**



**Figure 6: Cataract: Echogenic foci in anterior posterior cortex of the lens parenchyma.**



**Figure 7 A&B: Mass lesion occupying eye ball with multiple small calcific foci & internal vascularity(Retinoblastoma).**

## Conclusion

Our cases are predominantly of intraocular (78%) pathology compared to extraocular lesion. Commonest ocular pathology in our study was retinal detachment & cataract with equal weightage (20.5 %) followed by vitreous hemorrhage (15.3 %). The distinction between ocular and extraocular pathologies was made in 100% of cases with the help of USG. Out of 50 cases, 47 cases were diagnosed correctly on USG compared to 16 cases by ophthalmic examination. The overall sensitivity, specificity, PPV, NPV and accuracy of ultrasound for the diagnosis of ocular pathologies were 93.2%, 100.0%, 100.0%, 66.6% & 94% respectively compared to 36.3%, 100.0%, 100.0%, 17.6% & 44% for ophthalmoscopic examination.

We conclude that USG was useful in diagnosing ocular conditions like tumors, traumatic lesions, lesions of lens and posterior segment pathologies. USG had better sensitivity and specificity for both intraocular and extraocular pathologies than ophthalmoscope due to opaque media. Moreover, B-mode real time ultrasonography with high frequency probes provide a cost-effective, radiation free, non-invasive technique in patients with ocular pathologies.

## References

1. Ethlers JP, AM J Ophthalmol.2008 sep;146(3): 427-E. Puodziuviene, ultrasound value in diagnosis, management and prognosis of severe eye injuries, ISSN 1392-2114 Ultragarsas, Nr.3(56).2005
2. Leo M, Carmody K. Sonography Assesment of acute ocular pathology. In: Langer JE(ed) Emergency ultrasound, an issue of ultrasound clinics. Vol 6. Philadelphia: WB Saunders; 2011:227-34.
3. Dr.Hemang. D.Chaudhri. Role of Ultrasonography in evaluation of orbital lesions. Gujarat Medical Journal Dec-2013 Vol.68 No.2
4. Bangal SV, Bhandari AJ, Siddhiqui F. Pattern of ocular pathologies diagnosed with B-scan ultrasonography in a hospital in rural india .Niger J Ophthalmol 2016;24:71-5.
5. Rosa M Lorente-Ramos, Araceli Munoz-Hernandez, Susana Bilbao de la Torre. US of the eye made easy: A comprehensive how to review with ophthalmoscopic correlation. E176 September-October 2012.
6. Zain Irfan Khatib & Seethalakshmi D K. Role of ultrasound in evaluating ocular and orbital diseases. Karnataka Institute of Medical Sciences .Vol.1, Issue 1, Dec 2016 , 1-14.
7. Marcela De La Hoz Polo, Anna Torramilans, Albert Anguera Bosque. Ocular ultrasonography focused on the posterior eye segment: What radiologists should know. Insights Imaging (2016) 7:351-364.
8. Grainger and Allison's : Diagnostic radiology, 6th edition, 2014 .
9. Nagaraju RM, Gurushankar G, Bhimarao, Kadakola B. Efficacy of High Frequency Ultrasound in Localization and Characterization of Orbital Lesions. J Clin Diagn Res 2015;9:1-6
10. Sharma OP. Orbital sonography with its clinico-surgical correlation.

### *Agrawal et al; High Resolution Ultrasonography (USG) In Ocular Pathologies*

- Ind J Radio Image 2005;15:537-54
11. Nagaraju RM, Gurushankar G, Bhimarao Kadakola B. Efficacy of High Frequency Ultrasound in Localization and Characterization of Orbital Lesions. J Clin Diagn Res. 2015;9:1-6
  12. Neeru Choudhary , Sameer R .Verma , Prashant Kumar Gupta. Evaluation of Orbital and Ocular Lesions on Sonography. e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 16, Issue 6 Ver. 1 (June. 2017), PP 50-58
  13. Hiren Rathod, Mahak Sood, Hiral Happani, Anjana Trivedi. Role of USG in ocular pathologies. International Journal of Contemporary Medicine Surgery and Radiology. 2018;3(3):C82-C85.
  14. Jemeld B, Algvere P, Singh G. An ultrasonographic study of diabetic vitreo-retinal disease with low visual acuity. Acta Ophthalmologica 1980;58:193-201.
  15. Zilelioglu G, Gündüz K. Ultrasonic findings in intraocular retinoblastoma and correlation with histopathologic diagnosis. Yan Ke Xue Bao 1997 Jun;13(2):56-8.

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